

DIVERSITY, SPECIES COMPOSITION AND DISTRIBUTION OF ODONATES  
(ODONATA) IN JOHOR STATE, PENINSULAR MALAYSIA

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Special thanks to my beloved parents and sisters for all their support, love and encouragement. *“I am truly nothing without all the support and love from all of you”.*



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## ABSTRACT

Johor is undergoing rapid socioeconomic development; some forms of prioritization of conservation area are needed as the best resemblance of original biodiversity. Through effective management, it would assist the state for a better conservation practice. The purpose of this research is to provide a baseline data of odonates in Johor to facilitate prioritization of conservation areas as well as in planning, managing and sustainable usage of biodiversity. The objectives of this research are to determine the diversity and species composition of odonates in selected sites in Johor, to map distribution pattern based on faunistic and ecological aspects and to identify identify prioritize conservation areas and potential sites for odonate tourism using priority grid analysis based on specific criteria. Samplings were carried out from November 2016 to October 2017 in nine selected sites in Johor. Adult odonates were collected using aerial net in each of the 21 stations located at equidistant of 50 m along a one km transect for a total of 648 man-hours. The species distribution map of odonate was determined using both direct and indirect approaches in visualizing the distribution patterns. Total of 2,222 individuals of 84 species from 13 families and 58 genera were recorded. From all the nine sites, Libellulidae was the most well-represented family in terms of species richness (44%) and abundance (59%). Shannon Diversity Index ( $H'$ ), and Species Evenness Index ( $E'$ ) were highest in Taman Negara Johor Endau-Rompin ( $H'= 3.16$ ;  $E'= 0.73$ ) and lowest in Hutan Lipur Soga Perdana ( $H'= 2.44$ ;  $E'= 0.50$ ). The site with highest priority was Hutan Lipur Sungai Bantang with a score value of 62 while the lowest priority was recorded in Hutan Lipur Gunung Pulai with a score value of 23. Similarly, site with the highest potential towards odonate tourism was Hutan Lipur Sungai Bantang with score value of 99 and Hutan Lipur Gunung Pulai being the lowest with score value of 55. This study indicated the usefulness of species distribution mapping as a tool to prioritize conservation areas. In addition, this study reveals the potential of odonates as product for entomotourism in Johor.

## ABSTRAK

Johor mengalami perkembangan sosioekonomi yang pesat, keutamaan perlu diberikan kepada kawasan pemuliharaan yang seringkali menjadi perwakilan bagi biodiversiti. Pengurusan yang berkesan akan membantu pemuliharaan yang lebih baik. Penyelidikan ini bertujuan menyediakan rekod odonata di Johor dan penilaian sesebuah kawasan pemuliharaan melalui aspek perancangan, pengurusan dan penggunaan biodiversiti secara lestari. Objektif kajian ini bertujuan menentukan kepelbagaian dan komposisi spesies odonata di negeri Johor, menentukan corak taburan spesies dari aspek faunistik dan ekologi melalui pemetaan, dan mengenalpasti kawasan berpotensi untuk pemuliharaan dan pelancongan odonata berdasarkan kriteria yang ditetapkan. Persampelan dijalankan daripada November 2016 sehingga Oktober 2017 di sembilan buah kawasan di Johor. Persampelan dijalankan menggunakan jaring udara di 21 stesen dengan jarak 50m antara stesen sepanjang transek 1km dengan jumlah keseluruhan 648 jam bekerja. Peta taburan spesies dihasilkan menggunakan pendekatan langsung dan tidak langsung dalam menggambarkan pola taburan spesies. 2,222 individu dari 84 spesies mewakili 13 famili dan 58 genera telah direkodkan. Sembilan kawasan kajian, Libellulidae merupakan famili yang paling dominan dari segi kekayaan spesies (44%) dan kelimpahan (59%). Indeks Kepelbagaian Shannon ( $H'$ ) dan Indeks Kesamarataan Spesies ( $E'$ ) tertinggi di Taman Negara Johor Endau-Rompin ( $H' = 3.16$ ;  $E' = 0.73$ ) dan terendah di Hutan Lipur Soga Perdana ( $H' = 2.44$ ;  $E' = 0.50$ ). Kawasan dengan keutamaan tertinggi adalah Hutan Lipur Sungai Bantang dengan nilai skor 62 dan terendah dicatatkan di Hutan Lipur Gunung Pulai dengan skor 23. Hutan Lipur Sungai Bantang mencatatkan skor tertinggi iaitu 99 sebagai kawasan paling berpotensi untuk tujuan pelancongan odonata, manakala Hutan Lipur Gunung Pulai mencatatkan skor terendah iaitu 55. Kajian ini menunjukkan kegunaan pemetaan taburan spesies sebagai alat untuk menentukan kawasan pemuliharaan. Kajian ini juga menyerlahkan potensi odonata sebagai produk entomopelancongan di Johor.

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## LIST OF SYMBOLS AND ABBREVIATIONS

°C	-	Degree Celsius
a.s.l.	-	Above sea level
ft.	-	Feet
E'	-	Evenness Index
H'	-	Shannon Diversity Index
IUCN	-	International Union for Conservation of Nature
km	-	Kilometer
m	-	Meter
mm	-	Millimeter
N	-	Number of individual
n	-	Number of species
PAST	-	Paleontological statistics
S1	-	Site 1 (Taman Negara Johor Gunung Ledang)
S2	-	Site 2 (Taman Negara Johor Endau-Rompin)
S3	-	Site 3 (Hutan Lipur Gunung Arong)
S4	-	Site 4 (Hutan Lipur Sungai Bantang)
S5	-	Site 5 (Hutan Lipur Soga Perdana)
S6	-	Site 6 (Hutan Lipur Gunung Belumut)
S7	-	Site 7 (Hutan Lipur Gunung Pulai)
S8	-	Site 8 (Hutan Lipur Gunung Panti)
S9	-	Site 9 (Sungai Sayong)
Sg.	-	Sungai (River)
TNJER	-	Taman Negara Johor Endau-Rompin
TNJGL	-	Taman Negara Johor Gunung Ledang
UTHM	-	Universiti Tun Hussein Onn Malaysia
>	-	Greater than
<	-	Less than

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## LIST OF PUBLICATIONS

### Proceedings/ Conferences/ Seminars

#### Oral Presentations

1. Zulhusni, Z., **Abdul-Aziz, M.A.A.** & Maryati, M. (2017) Preliminary checklist of odonata (dragonflies and damselflies) at Hulu Sedili Besar Forest Reserve, Johor, Malaysia in *Seminar Warisan Semulajadi Johor 2017 on 13-14 March 2017 at M Suite Hotel, Johor Bahru, Johor. (In press.)*
2. **Abdul-Aziz, M.A.A.** & Maryati, M. (2018). Diversity and Species Composition of Odonates (Insecta: Odonata) of Hutan Lipur Soga Perdana, Batu Pahat, Johor, Malaysia: A Green Lung in 3rd International Conference on the Application of Science and Mathematics 2017 on 24-25th October 2017 at Convention Centre Edu Hub Pagoh, Muar, Johor. *Journal of Science and Technology, 10(2)*, pp. 1- 9.
3. **Abdul-Aziz, M.A.A.**, Maryati, M. & Tokiman, L. (2018). Faunistic studies of odonates (Insecta: Odonata) in Johor, Malaysia. *Serangga. (In press.)*

#### Module

- i. Maryati, M. & **Abdul-Aziz, M.A.A.** (2017). *Knowledge Transfer Programme (KTP): Odonata (Dragonflies & Damselflies) Module for Nature Tourist Guide of Johor.* Universiti Tun Hussein Onn Malaysia. **(Unpublished).**

## LIST OF AWARDS

1. **Second-place in Three Minute Thesis Competition for Master's Category [3MT 2017] UTHM:**

Universiti Tun Hussein Onn Malaysia: “Prioritizing Conservation Areas Based on Diversity and Distribution of Odonates in Selected Water Bodies of Johor.”



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## CHAPTER 1

### INTRODUCTION

#### 1.1 Background of the study

Insects are important because of their diversity, ecological role, and influence on agriculture, human health, and natural resources (Scudder, 2009). Insects are common and widespread throughout the world and that makes it difficult to believe that many species of insects are endangered. Unlike other insects, odonate is one of the groups of insects that are seldom considered in any conservation measures (Rivera, 2000). This might be due to the lack of research studies that focused on the distribution, conservation status and their ecological importance. As stated by Dalzochio *et al.* (2011), one of the biggest problems for conservation in tropical forests is the lack of information to establish priorities and concentrate efforts on practical actions.

Odonates are valuable as biological indicators of both aquatic and terrestrial ecosystem health (Malawani *et al.*, 2014). They also play a crucial role in the food web as herbivores, carnivores and detritivore (Qayyimah *et al.*, 2014). The larvae of odonates are predators in aquatic food chain while the adult are predators of pests of crops and plantations (Kandibane *et al.*, 2005; Qayyimah *et al.*, 2014).

Order Odonata can be divided into three groups which are Zygoptera (damselflies), Anisoptera (dragonflies) and Anisozygoptera. Anisozygoptera is morphologically similar to Anisoptera but with narrow wing base as in Zygoptera (Subramanian, 2009). According to Orr *et al.* (2004), Odonata (dragonflies and damselflies) are distributed worldwide. Odonata can be found in various kinds of habitats ranging from permanent running water (lotic) and lakes (lentic) to rain pools

(Acquah-Lampitey *et al.*, 2013). There are 5952 described species (Dijkstra *et al.*, 2013) and the greatest number was found in forested tropical region (Nelson *et al.*, 2011). Odonata is widely distributed in the tropical rainforest where the greatest numbers and diversity occur (Wahizatul-Afzan, 2006). The larvae are aquatic while adults are aerial predatory insects and usually active during daytime (Choong *et al.*, 2017a).

Presently, people are becoming more interested in nature-based tourism and this idea shows that there is a potential for invertebrates (Saikim *et al.*, 2015) such as odonates to be highlighted as the focus of ecotourism activities. The main advantage of involving invertebrates into ecotourism activities is higher awareness of the crucial roles of invertebrates in our ecosystems (Huntly *et al.*, 2005). From the mapping technique used in this study, areas that has the highest diversity and species distribution were identified. These areas are suggested to be prioritized as a conservation area and proposed as a 'Dragonflies and Damselflies Trail'. As stated in Buckley (2003), the best way for tourism to contribute towards conservation is by funding the establishment and operation of private conservation reserves. The data collected throughout the research period and the checklist of odonates species were compiled in a database and used as a medium for promoting entomotourism package particularly in Johor. For example, a similar tour is offered in Mexico to observe the spectacles of the annual migration of millions of Monarch Butterflies as stated by Huntly *et al.*, (2005).

The study on the diversity of odonates has been done extensively throughout the region and new findings have been recorded from time to time. Most studies (Choong & Cheah, 2013; Mapi-ot *et al.*, 2013; Maryati *et al.*, 2014; Yuto *et al.*, 2015; Rafi *et al.*, 2017; Subramanian & Babu, 2018) are concentrated in the tropical region where the highest diversity and endemism were recorded. Therefore, it is important to make sure the undisturbed and well-vegetated tropical aquatic habitats remained undisturbed to sustain the odonates population especially the stenotopic, secretive and vulnerable endemic species. This can be done through prioritizing of the conservation areas as suggested by several studies (Simaika & Samways, 2012; Gerber *et al.*, 2014; Doxa *et al.*, 2017).



## 1.2 Problem statement

Most studies focused on the diversity and species composition of odonates in tropical regions (Wilson & Gibert, 2006; Norma-Rashid, 2009; Dalzochio *et al.*, 2011; Mamat *et al.*, 2012; Choong *et al.*, 2012; Das *et al.*, 2012; Mapi-ot *et al.*, 2013; Malawani *et al.*, 2014; Basumatary *et al.*, 2015; Yuto *et al.*, 2015, Siregar & Bakti, 2016). However, the studies on the distribution patterns and prioritization using odonates are still lacking. Although, significant amount of studies have been conducted in various parts of Johor (Choong & Cheah, 2013; Maryati *et al.*, 2014; Siddiki, 2015), they focused on providing a checklist of odonate fauna. Furthermore, the rapid development of human settlement areas, agricultural activities (oil palm plantation) and industries in Johor had caused a reduced in total forested land areas of Johor. According to Johor Forest Management Plan of 2016-2025 and Ng & Lim (2017), the total of remaining forested land areas in Johor is about 20%. Therefore, there is a need for prioritization of conservation areas in Johor especially the areas that have high endemism and protected (unpolluted) water bodies. This thesis is a scientific endeavor to integrate a study of diversity, species composition and distribution with mapping and prioritization of protected areas. Through mapping of odonates species, potential sites for odonate tourism (entomotourism) were determined. The sites were evaluated based on several criteria including diversity, habitat and nature tourism potential. The comparison made through this research will provide the overview of odonate fauna (checklist) and their distribution patterns (mapping) in Johor. The main purposes of this documentation are to provide a baseline data for odonate fauna in Johor, assess their conservation status and monitor of any long-term changes towards odonate fauna in future. This is part of an effort towards odonates conservation and systematic management of protected areas in Johor.





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